

It has been observed that the drive train components tend to separate at the end of injection, and as the components are subsequently brought into contact an undesirable level of mechanical noise may be generated.

- 5 It is one object of the present invention to provide a control method for a fuel injection system generally of the aforementioned type, in which the problem of mechanical noise is alleviated.

- There is also an increasing need in the automotive industry to reduce emissions levels, for example NOx and smoke levels, both for environmental purposes and to improve engine efficiency, and it is a further object of the invention to provide a control method which provides beneficial emissions levels.

- According to a first aspect of the present invention, there is provided a control method for a fuel injection system having a spill valve, a nozzle control valve and a valve needle which is engageable with a seating to control fuel injection, the method comprising:

- applying a first drive current signal to the spill valve to cause the spill valve to move into a closed state and applying a second drive current signal to the nozzle control valve to cause the nozzle control valve to move to an open state, thereby to lift the valve needle from the seating to initiate a main injection of fuel, followed by

- modifying the first drive current signal applied to the spill valve so as to cause the spill valve to move from the closed state to an open state during a spill valve

terminating the main injection of fuel by (i) actuating the spill valve at a first time to cause the spill valve to move into an open state followed by (ii) actuating a nozzle control valve at a second time to cause the nozzle control valve to move into a  
5 closed state,

subsequently actuating the spill valve at a third time to cause the spill valve to move from its open state to a closed state, and

10 initiating the post injection of fuel by actuating the nozzle control valve to move into an open state, whereby the difference between the first and third times is selected to provide a relatively high pressure post injection of fuel so as to reduce smoke emissions levels.

15 It has been found to be desirable to provide a main injection of fuel followed by a post injection of fuel to improve emissions.

The present invention provides an advantage over methods whereby only the nozzle control valve is activated to initiate a main and a post injection of fuel, for which  
20 structural problems arise due to stresses within the apparatus caused by extremely high pressure levels.

In a preferred embodiment, the spill valve is actuated to move between its open and closed states by modifying a spill valve drive current signal. Preferably, the relative